



A REVIEW ON PHYTOCHEMISTRY AND PHARMACOLOGY OF AVERRHABILIMBI LINN.

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ABSTRACT

Averrhoabilimbi Linn. is principally cultivated for medicinal purposes in many tropical and subtropical countries of the world. Literature survey about this plant shows that *A. bilimbi* is mainly used as a folk medicine in the treatment of diabetes mellitus, hypertension and as an antimicrobial agent. The prime objective of this review is to accumulate and organize literatures based on traditional claims and correlate those with current findings on the use of *A. bilimbi* in the management of different ailments. Several pharmacological studies have demonstrated the ability of this plant to act as antidiabetic, antihypertensive, thrombolytic, antimicrobial, antioxidant, hepatoprotective and hypolipidemic agent. *A. bilimbi* holds great value in the complementary and alternative medicine as evidenced by the substantial amount of research on it. Therefore, we aimed to compile an up-to-date and comprehensive review of *A. bilimbi* that covers its traditional and folk medicine uses, phytochemistry and pharmacology. Hence, this paper presents an up-to-date and comprehensive review on the ethno-medicinal uses, different chemical constituents and pharmacological activities of *A. bilimbi*. So far, the biologically active agents have not been isolated from this plant and this can be a good scientific study for the future antidiabetic, antihypertensive and antimicrobial implications. Hence, this review targets at emphasizing the diverse traditional claims and pharmacological activities of *A. bilimbi* with respect to carrying out more scientific studies to isolate active principles through advanced technology.

KEYWORDS: *Averrhoabilimbi* Linn., traditional uses, pharmacological activities, phytochemistry

Introduction

Plant has been an important source of medicine since antiquity. The oldest known record of plant being used for a therapeutic purpose is found in Egyptian medical papyrus written in the fourteen century.^[1] Since then, preparations of plant materials in the form of decoction, infusion, powder or paste have been used in traditional medicine for prevention and treatment of different diseases and for improving the general well-being. According to the World Health Organization (WHO), about 80% of people living in Africa and Asia use the traditional medicine to help meet some of their primary health care needs.^[2] The key emphasis of this review article is to establish the utilitarian side and medicinal characteristic of *A. bilimbi* and turn that into drug for future antidiabetic and antihypertensive drug implications. The methodology followed was to methodically collect, organize and chart the recent advances in the use of *A. bilimbi* in different chronic disorders. Data were retrieved from Medline, Pubmed, EMBase and Science Direct databases covering traditional and scientific literature related to *A. bilimbi*'s potential role for the treatment of various diseases have been thoroughly evaluated and discussed. Moreover, this review aims at highlighting the diverse traditional claims and pharmacological activities of *A. bilimbi*.

Averrhoabilimbi Linn.

A. bilimbi (common name: Bilimbi) is a medicinal plant belonging to the family Oxalidaceae. The genus *Averrhoa* was named after an Arab Philosopher, physician and Islamic Jurist Ibn Rushd often known as Averroes (1126-98).^[4] *A. bilimbi* is closely related to *Averrhoacarambola* (carambola, starfruit). It originated in Southeast Asia and is claimed as a native by West Malaysia and the Indonesian Moluccas.^[6] It is cultivated throughout Malaysia, Indonesia, Singapore, Philippines, Thailand, Bangladesh, Myanmar, and India. It also extends to other countries like United States, Argentina, Australia, Brazil, Colombia, Ecuador, Jamaica, Puerto Rico, Tanzania and Trinidad and Tobago. The other common names of *A. bilimbi* are bilimbi, cucumber tree, tree sorrel, pickle tree (English); kamias, camias, pias (Philippines); ta

ling pling (Thai); huanguashu (Chinese); bilimbin, biri-biri, limao de caiena, azedinha (Brazil); vilimbipuli, irumpanpuli, bilimbi (India); khetay (Vietnamese); talingpling (Thailand), belimbingbuluh, blimbingasam (Malaysia).^[6]

A. bilimbi is a small tree which grows up to 15 m high with sparsely arranged branches. It has compound leaves with 20-40 leaflets each and 5-10 cm long.^[7] The leaves are hairy with pinnate shapes and form clusters at the end of branches.^[6,8] The tree is cauliflorous with 18-68 flowers in panicles that form on the trunk and other branches. The flowers are heterostylous with petal 10-30 mm long, yellowish green to reddish purple.^[6,9] The fruits are produced on the bare stem and trunk. The fruits are greenish in colour with firm and juicy flesh which becomes soft on ripening.^[7] The fruit juice is sour and extremely acidic. *A. bilimbi* holds great value in complementary medicine as evidenced by the substantial amount of research on it. Therefore, we aimed to compile an up-to-date and comprehensive review of *A. bilimbi* that covers its traditional and folk medicine uses, phytochemistry and pharmacology.

Scientific Classification

Kingdom: Plantae – Plants
Subkingdom: Tracheobionta – Vascular plants
Superdivision: Spermatophyta – Seed plants
Division: Magnoliophyta – Flowering plants
Class: Magnoliopsida – Dicotyledons
Order: Geraniales
Family: Oxalidaceae – Wood-Sorrel family
Genus: *Averrhoa* Adans. – *averrhoa*
Species: *Averrhoabilimbi* L. – bilimbi

Ethno medicinal uses

A. bilimbi has been used in the traditional medicine for the treatment of variety of ailments. Infusions and decoctions of the leaves are used as an antibacterial, antiscorbutic, astringent, postpartum protective medicine, in treatment of fever, inflammation of the rectum, and diabetes.^[9] Paste of leaves is used in the

treatment of itches, boils, skin eruptions, bites of poisonous creatures, rheumatism, cough, cold, mumps and syphilis.^[10-11] Grated fruits, with a little salt added, are applied on the face to treat pimples.^[12] Fruit juice is employed in the treatment of scurvy, bilious colic, whooping cough, hypertension, obesity and diabetes.^[10,12-13]

Phytochemical constituents

Fruits: In an analysis conducted on Malaysia's *A. bilimbi* fruits, 53 different components were identified as the volatile constituents. Aliphatic acids constitute 47.8% of the total volatiles. The main constituents were hexadecanoic acid [palmitic acid] (20.4%), 2-furaldehyde (19.1%) and (Z)-9-octadecenoic acid (10.2%). Twelve of the compounds identified were esters among which butyl nicotinate (1.6%) and hexyl nicotinate (1.7%) were present in higher quantities.^[14]

In another study, Pinoet al. investigated the volatile constituents of *A. bilimbi* that is grown in Cuba. The fruit pulp had approximately 6 mg/kg of total volatile components from which 62 compounds were identified. The major compounds were nonanal (2.7mg/kg), (Z)-3-hexenol (0.48mg/kg), hexadecanoic acid (0.31mg/kg), octane (0.29), tricosane (0.27mg/kg), (E)-2-decenal (0.26 mg/kg), nonanoic acid (0.25mg/kg), (Z)-9-pentacosene (0.24 mg/kg), 2-furfural (0.18 mg/kg), and (Z)-9-tricosene (0.11mg/kg). The remaining compounds were present in infinitesimal quantities (less than 0.1 mg /kg). The series of C-9 compounds: nonanal, nonanoic acid and (E)-2-nonenal provide the *A. bilimbi* fruit with its characteristic fatty and green notes. The second most dominant compound viz. (Z)-3-hexenol is also believed to contribute to the green notes of the fruit.^[15] Preliminary phytochemical studies of the fruit extracts using chemical methods and thin layer chromatography revealed the presence of carbohydrates, proteins, amino acids, flavonoids, tannins, bitter principles, essential oil, valepotriates, coumarin and terpenes. The fruits are also rich in vitamin C and oxalic acid.^[16-17] The isolation of 2,4-Dihydroxy-6-((4-methylpentyl)oxy) methyl benzaldehyde from the fruit extract has also been reported.^[18]

Leaves: The preliminary phytochemical screening of the leaves extracts revealed the presence of alkaloid, tannins, saponins, flavonoids, cardiac glycosides, glycosides, triterpenes, phenols and carbohydrates.^[19-20] Gunawan et al. reported the isolation of seven compounds from the leaves methanol extract of *A. bilimbi*. These include squalene, 3-(6,10,14-trimethylpentadecan-2-yl)furan-2(5H)-one, 2,3-bis(2,6,10-trimethylundeca-1,5,9-trienyl) oxirane, phytol, 3,4-Dihydroxyhexanedioic acid, malonic acid and 4,5-Dihydroxy-2-methylenehydroxybenzaldehyde.^[18]

Pharmacology

The traditional claims as well as roles for the efficacy of *A. bilimbi* in the treatment of various infectious and non-infectious diseases have been confirmed by several relevant scientific studies. Numerous pharmacological investigations, including *in vitro* and *in vivo* (animal) studies have been carried out on the leaves and fruits of *A. bilimbi*. A wide range of pharmacological activities such as antidiabetic, antihypertensive, antithrombotic, hypolipidemic, hepatoprotective, cytotoxic, antimicrobial, wound healing, anthelmintic and antioxidant have been reported by different researchers so far.

Role of *A. bilimbi* as an antimicrobial agent

Antimicrobial agents are among the most frequently used drugs in human medicine and veterinary practices. The widespread development of antimicrobial resistance in recent years, had led to a renewed search for newer antimicrobial agents for the treatment of infectious diseases. The leaves ethanol extract of *A. bilimbi* was reported to exhibit appreciable antimicrobial activity against six pathogenic microorganisms viz. two Gram positive bacteria (*Bacillus cereus* and *Bacillus megaterium*), two Gram negative bacteria (*Escherichia coli* and *Pseudomonas aeruginosa*) and two fungi (*Aspergillus ochraceus* and *Cryptococcus neoformans*).^[21] The aque-

ous and chloroform extracts of *A. bilimbi*'s leaves and fruits (100 mg/ml) showed positive antibacterial activity against *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Bacillus cereus*, *Salmonella typhi*, *Citrobacter freundii*, *Aeromonas hydrophila*, *Proteus vulgaris* and *Kocuriarhizophila*.^[22] Whole bilimbi fruit and blended bilimbi juice (not filtered) at a concentration of 1:2 and 1:4 w/v respectively displayed significant activity against *Listeria monocytogenes* Scott A, and *Salmonella typhimurium* in an *in vitro* antibacterial assay. The fruit preparations were also found to reduce the microbial load of *L. monocytogenes* Scott A and *S. typhimurium* on raw shrimps after washing and during storage (4 °C). This demonstrated the potential of *A. bilimbi* fruits to be adopted as a natural method of decontaminating shrimps just before preparation and consumption.^[23] In another study, fruits and roots extracts of *A. bilimbi* were also found to exhibit the positive activity against *Mycobacterium tuberculosis* with MIC of 1600 µg/ml.^[24] The leaves extracts have also been reported to display moderate antifungal activity against *Blastomyces dermatitidis*, *Candida albicans*, *Cryptococcus neoformans*, *Pityrosporum ovale*, *Trichophyton spp.* with MIC values ranging from 15.65-62.50 µg/ml.^[25]

Role of *A. bilimbi* as an antioxidant agent

Antioxidants are compounds that interact with and neutralize free radicals, thus preventing them from causing cellular damage. The therapeutic potential of antioxidants in diseases associated with oxidative stress (e.g., cancer, diabetes mellitus and neurodegenerative disorders) has gained much attention in recent years. The result obtained revealed that *A. bilimbi* leaves extracts (0.02% w/v) displayed moderate antioxidant activity in ferric thiocyanate and thiobarbituric acid methods while it was found to be inactive in 2,2-Diphenyl-1-(2,4,6-trinitrophenyl)hydrazyl (DPPH) assay. Unlike the leaves, the fruits extracts showed strong DPPH radical scavenging activity with IC₅₀ value of 20.35 µg/ml. It also displayed remarkable total antioxidant capacity (417.093 ± 6.577 mg/g in ascorbic acid equivalent (AAE)).^[26] This finding was further confirmed by other researchers who conducted similar studies.^[27-28] Precious et al. studied photoprotective effect of leaves ethanol extract of *A. bilimbi* against ultraviolet light (UV) (200-400nm) induced oxidative damage in albino mice. The study revealed that topical application of extract (4%) decreased the effect of UV light-induced photo-aging in mice skin by decreasing malondialdehyde level by up to 50% compared to an irradiated control group. The extract treated animals also showed minimal signs of histological changes and dermatitis compared with the untreated group. This finding suggests that the leaves may possess some anti-aging agents.^[29]

Role of *A. bilimbi* as a hepatoprotective agent

The liver is a vital organ in the body which performs major role in the metabolism, secretion, storage and detoxification of chemical substances. Hepatoprotective activity is the ability of a compound or extract to prevent liver damage. The methanol extract of *A. bilimbi* leaves exhibited appreciable hepatoprotective activity against carbon tetrachloride (CCl₄) induced liver toxicity in Wistar rats. Nagmoti et al. reported that methanol extract of *A. bilimbi* (250 and 500 mg/kg, p.o.) significantly (p< 0.01) prevented CCl₄-induced elevation of levels of some biomarkers for liver damage which include serum glutamate oxaloacetate transaminase (SGOT), serum glutamate pyruvate transaminase (SGPT) and alkaline phosphatase (ALP), total protein and bilirubin in rat.^[30] Moreover, the fruits extracts at a dose of 250 mg/kg.b.wt and 500 mg/kg.b.wt have also been reported to demonstrate significant hepatoprotective activity against acetaminophen induced liver damage in Wistar rat.^[31]

Role of *A. bilimbi* as an anticancer agent

Cytotoxicity assays are used to determine whether a compound or extract is toxic to cells. Cytotoxicity testing methods are routinely used in the screening of antitumor drugs. Ethanol extract of *A. bilimbi* leaves has been shown to possess moderate cytotoxic

activity (LC_{50} , 5.81 μ g/l) in brine shrimp lethality assay.^[20] In another study, the methanol extract of fruits and its carbon tetrachloride and petroleum ether fractions demonstrated a significant cytotoxic potential (LC_{50} of 0.005 μ g/ml, 1.198 μ g/ml and 0.781 μ g/ml, respectively) compared to vincristine sulfate (with LC_{50} of 0.839 μ g/ml). In another similar study, the LC_{50} values of chloroform and aqueous soluble fractions were found to be 5.691 and 6.123 μ g/ml, respectively.^[32]

Role of *A. bilimbi* as a wound healing agent

Several medicinal plants have been shown to possess significant healing effect. In this regard, the use of *A. bilimbi* in treating oral injuries has been scientifically investigated as well. Igaa conducted a study to evaluate the effect of *A. bilimbi* leaves extract on the healing of gingiva wound. The result obtained showed that application of ethanol extract of *A. bilimbi* leaves (10% conc.) enhanced gingiva wound healing which was indicated by significant increase in the number of fibroblast in the rat gingival wound compared to untreated group.^[35]

Role of *A. bilimbi* as an antidiabetic agent

Diabetes mellitus (DM) affects hundreds of millions of people across the world. DM is a complex metabolic disorder resulting from either insulin insufficiency or insulin dysfunction. It is a major public health problem that affects over 400 million people worldwide.^[34] Scientific investigations revealed that *A. bilimbi* possesses antidiabetic properties. Pushparaj et al. evaluated the hypoglycemic and hypolipidemic effects of *A. bilimbi* leaves extract in STZ induced diabetic rats. In this study, it was observed that the leaves ethanol extract (125 mg/kg twice daily p.o.) significantly lowered blood glucose and triglyceride levels when compared with the vehicle.^[35] In another study, Pushparaj et al. examined the possible mechanism of the hypoglycemic action of hexane, ethylacetate, butanol and aqueous fractions of *A. bilimbi*'s leaves ethanol extract in streptozotocin-diabetic male Sprague-Dawley (SD) rats. The hypoglycemic property of different fractions was assessed at a dose of 125-mg/kg-body weight in streptozotocin (STZ)-diabetic rats. Results obtained showed that an oral administration of the aqueous fraction to STZ induced diabetic rats significantly enhanced insulin secretion and improved glucose tolerance while hepatic glucose-6-phosphatase activity was lowered. The resultant increase in serum insulin level was presumed to be the possible mechanism of action of the plant.^[36] In a similar study conducted by Tan et al. in a high fat diet (HFD) fed streptozotocin (STZ)-induced diabetic rats, aqueous fraction and butanol fractions of leaves ethanol extract resulted in significant hypoglycemic and hypotriglyceridemic effects.^[37] In another *in vitro* study against digestive enzymes, leaves ethanol extract was reported to show α -glucosidase inhibitory activity and the same extract was found to be inactive against α -amylase enzyme.^[38]

^[39] Moreover, Pan investigated the effect of *A. bilimbi* on insulin signaling pathway. It was observed that different leaves extracts exhibit strong inhibition of protein tyrosine phosphatase 1B (PTP1B) in an *in vitro* enzyme assay at 10 μ g/ml. The diethyl ether extract demonstrated the strongest inhibition with 0.7 % residual PTP1B activity followed by petroleum ether extract with 5.7 %, while butanol and water extracts displayed relatively less potency with residual PTP1B activity of 34.9 % and 35.0 %, respectively.^[40]

Role of *A. bilimbi* as an antihyperlipidemic agent

The lipids in the body are mainly represented by cholesterol, triglycerides and phospholipids. Elevated blood lipid levels are major risk factors for the development of cardiovascular diseases, coronary artery disease, cerebrovascular disease, and peripheral vascular disease. These conditions often lead heart attacks and strokes. Several medicinal plants have been scientifically evaluated for their lipids lowering property with respect to control aforementioned disorders. Pharmacological investigations have revealed that *A. bilimbi* possesses lipid lowering property. Pushparaj investigated the hypoglycemic and hypolipidemic activities of an ethanol extract of leaves. It was observed that

repeated administration of the ethanol extract of leaves (250mg/kg/day) significantly lowered blood triglyceride by 130% when compared with the vehicle in streptozotocin induced diabetic rats. The treatment significantly increased the anti-atherogenic index and HDL-cholesterol to total cholesterol ratio.^[35] The leaves extract has also been shown to cholesterol uptake inhibition in an *in vitro* assay using the Caco-2 cells model of intestinal absorption. The fruit (125 mg/kg) as well as its aqueous extract (50 mg/kg) were also found to be effective in lowering lipids in the high fat diet fed rats.^[41]

Role of *A. bilimbi* as an antihypertensive agent

Hypertension is considered a major risk factor for several cardiovascular diseases such as atherosclerosis, heart failure, stroke, coronary artery disease and renal insufficiency. According to World Health Organization (WHO), about one-third of the world's population suffers from hypertension and the incidences have been increasing at an alarming rate owing to the unique life style modification. Recently, attention has been greatly concentrated on the use of herbal preparations as alternative agents to cure and prevent cardiovascular complications. Ethnobotanical surveys of various medicinal plants indicate their vast use in the treatments of cardiovascular disorders. Traditionally, the fruits and leaves of *A. bilimbi* have also been efficaciously used for blood pressure symptom. In this regard, Biphat et al. scientifically investigated the antihypertensive potential of aqueous extract of *A. bilimbi*'s leaves together with other plants using an *in vitro* isolated organ model. It was observed that the leaves aqueous extract significantly decreased the contractility of the norepinephrine-stimulated guinea pig atria without affecting their beating frequency.^[42] The leaves extract also demonstrated significant antihypertensive effect in an *in vivo* experiment using cats revealing the ability of leaves extract to become a potential antihypertensive drug.^[43]

Role of *A. bilimbi* as an antithrombotic agent

Anticoagulant herbs are used as an antithrombotic agent. Anticoagulant herbs are efficaciously used in angina, hepatitis, coronary artery disease, dysmenorrhea, rheumatoid arthritis, traumatic injury, tumors, depression, renal failure, stroke prevention and post-stroke syndrome. The anticoagulant activity of *A. bilimbi* was reported by Daud et al. in normal and alloxan induced diabetic rats.^[44] In their experiments, they found that oral administration of ethanol extracts of leaves and fruits (250 mg/kg) for 14 days were able to cause significant anticoagulant effect as observed by increased prothrombin time. In another similar study, crude methanol extract and partitioned fractions of leaves demonstrated significant thrombolytic activity (17.06 - 27.72%) in an *in vitro* assay.^[45]

Toxicity

A. bilimbi's fruit contains large amount of oxalic acid. Excessive consumption of the fruit juice can lead to increased serum oxalate level and accumulation of calcium oxalate crystals in renal tubules which can cause acute kidney failure. Bakul et al. reported a series of cases from five hospitals in the State of Kerala (India) who developed acute renal failure after drinking the fruit juice (100-400 ml/day). All the patients had severe renal failure with serum creatinine ranging from 5.5 to 12.3 mg/dl, and kidney biopsy showed acute tubular necrosis with calcium oxalate crystals. Seven out of the ten patients required hemodialysis but fortunately all of them recovered to normal conditions after 2 to 6 weeks of treatment.^[46] Nair et al. further reported two additional cases of acute nephropathy with tubular oxalate deposition following ingestion of fruit juice.^[47]

Bioprocessing of *A. bilimbi*

Since time immemorial, medicinal plants have been the reliable source for the herbal & traditional medicine practitioners to treat various disorders without even knowing about the presence of active principles responsible for the

assuagement of symptoms of the disease in the plants. However, recent significant advancements in technology have played crucial roles in health care setting in which medicinal plants have been set forth to different scientific evaluations to find out a variety of more efficacious and safe biologically active agents responsible for the various pharmacological activities of the medicinal plants. Hence, many phytoconstituents exhibiting encouraging and potent biological effects have been patented for the commercial pharmaceutical purposes to cure many disorders. Moreover, a particular plant of medicinal quality needs to be processed very carefully to preserve the pharmacological activity and threshold amount of the bioactive compounds from pre- and post-harvesting stress like ultra violet light, heat, chemical exposure, micro-organisms attack, moisture, etc.^[48] *A. bilimbi* is traditionally used as fresh juice, decoction, infusions or dried powder as wound healing, antidiabetic, antihypertensive, antihyperlipidemic agent etc.^[9-13] It is commercially found in many herbal products in different countries. Different types of organic solvents (dichloromethane, chloroform, ethylacetate, acetone, ethanol, methanol etc.) are extensively used to extract pharmacological active compounds from the plants of medicinal significance. However, these organic solvents have also been feasibly associated to generate cancer or other deleterious toxicities in the human body. Therefore, this reason alone rescinds the potential of herbal preparations that are prepared using toxic organic solvents.^[49] Hence, it is necessary to extract the medicinal plants using a green technology (toxic organic solvents free extraction methods) to control the process and produce nonhazardous herbal preparations, so that, the pharmacological effect of medicinal plant remains intact. With the enormous advancement of latest technology to be utilized and the effect of various extraction techniques yet to be properly studied on the medicinal plants, hence, there is still large unexplored area to be explored meticulously. For instance, supercritical fluid extraction (SFE) technique might be used to make toxic solvent free *A. bilimbi*'s antidiabetic or antihypertensive fractions that could have good commercialization prospect after appropriate scientific studies.^[48-49] Currently, SFE technique has become refined and sophisticated enough to yield controlled particles, particle generation from supercritical solution or suspensions (PGSS), micro-encapsulation using anti-solvent techniques (SAS).^[50] Such advanced and sophisticated analytical techniques can be successfully used to develop the bioactive fractions into pharmaceutical grade products in order to cure various disorders efficaciously.^[51] As SFE is organic solvent-free technique and is able to produce stable extracts that could be effectively employed as a good prospect to change a common medicinal plant into an efficacious drug at a cost-effective and a healthy way. Likewise, other extraction alternatives, like microwave assisted extraction (MAE) and ultrasonic assisted extraction (UAE) might also be used to recognize the better extraction method for this plant.^[52]

It is apparent from the extensive literature review that *A. bilimbi* possesses antidiabetic, antihypertensive, antithrombotic, hypolipidemic, hepatoprotective, anticancer, wound healing effects due to its strong anti-oxidative, anti-inflammatory and antimicrobial properties. It was found to show significant hypoglycemic as well as its antioxidative property which can be used against the oxidative stress and consecutive heart disease, stroke, cancer and liver damage. The antihyperlipidemic property can be used against hyperlipidemia making it an alternative to standard blood pressure lowering drugs. It possesses different pharmacological assets which can be efficaciously exploited for the management of many current global threats like diabetes mellitus, cardiovascular disorders and cancer. Moreover, it is a promising alternative to treat diabetes mellitus and its related complications all together in one shot and since this plant is abundant in nature, therefore, bio processing can be effectively and easily done using current green extractive methods like SFE, MAE or UAE to get high quality, organic trace free fractions and compounds that can be promising and potent new anti-diabetic,

antihypertensive or anticancer agents in the therapeutic managements of diabetes mellitus, hypertension or cancer as well as other chronic syndromes.

Conclusion:

A. bilimbi is an important medicinal plant used in traditional medicine for the treatment of various ailments and in maintaining good health and well-being. Extensive pharmacological research conducted over the years have proven the scientific bases for the therapeutic uses of *A. bilimbi*'s leaves and fruits in the treatment of several diseases including diabetes mellitus, hypertension and microbial infections. In contrast to several pharmacological investigations, few preliminary phytochemical studies have been reported on this plant and the compounds identified so far are mainly volatile oils, fatty acids and long chain hydrocarbons with weak medicinal value. Despite the beneficial use of *A. bilimbi* in complementary medicine and its scientifically proven pharmacological activities, there is a paucity of information on the bioactive compounds present in this plant. Given its interesting pharmacological profile, there is an urgent need to identify and isolate the bioactive constituents of this plant responsible for various biological activities. Isolation and characterization of bioactive compounds of different parts of *A. bilimbi* will provide an insight into the biochemical mechanism action of this plant. Knowledge of bioactive constituents will provide the bases for developing a new drug from the plant either as a pure compound or standardized extracts using advanced and sophisticated technology. The pure compounds exhibiting different pharmacological effects may also serve as lead for future drug development.

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